

UNIT IV-Respiration

Synopsis

- Respiration is an oxidative process taking place in all living cells.
- Respiration involves complete or partial oxidation of a respiratory substrate releasing energy. It also releases intermediate metabolite that participates in other metabolic activities.
- Respiration is almost similar in all living organisms with minor differences.
- Respiration is not similar in all organisms and all parts of the body at all times.
- In plants respiratory substrates may be starch, insulin, sucrose, stachyose sugar, proteins, fats, organic acids.
- Respiratory Quotient (R.Q) values are used in identifying the respiratory substrates at any time.
- R.Q is ratio between the volumes of carbon dioxide released to that of oxygen utilized. It is equal to one in case of carbohydrates, more than one in organic acids, less than one in fats. Proteins will have values between 0.8—0.9.
- Respiration may take place in the absence of oxygen (anaerobic respiration) in some bacteria and sometimes in all tissues of higher organisms.
- In eukaryotic cells respiration takes place in three different compartments of the cell—cytosol, mitochondrial matrix and inner membrane of mitochondria.
- In cytosol the reaction are referred as Glycolysis or EMP pathway. It is elucidated by **Embden, Mayerhoff and Paranas (EMP)**.
- Glucose formed by enzymatic reactions from respiratory substrates incompletely oxidizes to form 2 molecules of pyruvic acid.
- Glucose phosphorylates before entering into glycolysis. One oxidation reaction takes place in this process. Electron carrier is NAD. It is reduced to NADH₂.
- Four molecules of ATP are released in this process in substrate level phosphorylation reactions. Net gain is two ATP as two ATP are utilized in phosphorylations of glucose.
- In anaerobic respiration pyruvic acid decarboxylates and reduces to form ethyle alcohol or lactic acid or acetic acid. Net gain is only two ATP. In the absence of rates of anaerobic respiration tends to increases (Pasteur's effect).

- In the presence of oxygen pyruvic acid enters into mitochondrial matrix for further reactions called Krebs cycle or Tricarboxylic acid cycle or Citric acid cycle.
- isocitric acid dehydrogenase enzyme complex in the presence of six cofactors including NAD, FAD, and Co-A to form a two carbon compound Acetyl Co-A.
- Acetyl Co-A is the starting substance for Krebs cycle. It oxidizes completely releasing one ATP by substrate level phosphorylation and 3 molecules of reduced NAD and one molecule of reduced FAD.
- These reduced electron carriers enter into electron transport chain (ETC) in the inner mitochondrial membrane to release energy in the form of ATP and water called respiratory water.
- In the electron transport NADH₂ releases 3 molecules of ATP and one FADH₂ releases 2 molecules of ATP. NADH₂ from glycolysis releases only 2 ATP molecules if enters into ETC.
- One enzyme succinic acid dehydrogenase is membrane bound and participates in Krebs cycle and in ETC.
- Totally from a single mole of glucose 38 ATP molecules are formed (36 ATP net). In prokaryotes it is 40 and 38 due to the absence of mitochondria.
- In photorespiration which occurs in green pigments of plants during exposure to light glycolic acid is the respiratory substrate.